

WHAT IS CLAIMED IS:

1. A membrane scaffold protein that will, in an aqueous environment, self assemble in the absence of phospholipid or with a phospholipid or a mixture of phospholipids, into a nanoscale particle between about 5 nm and about 500 nm in diameter, wherein said membrane scaffold protein is amphipathic, and wherein said membrane scaffold protein forms at least one alpha helix.
2. The membrane scaffold protein of claim 1, wherein said membrane scaffold protein assembles with a phospholipid or a mixture of phospholipids into a nanoscale particle of about 5 nm and about 500 nm in diameter, wherein a phospholipid bilayer is formed.
3. The membrane scaffold protein of claim 2, wherein the phospholipid bilayer is discoidal.
4. The membrane scaffold protein of claim 1, wherein said membrane scaffold protein self assembles together with at least one hydrophobic or partially hydrophobic protein to form a nanoscale particle between about 5 nm and 500 nm in diameter, said nanoscale particles comprising the membrane scaffold protein and the at least one hydrophobic or partially hydrophobic protein.
5. *Revised* The membrane scaffold protein of any of claims 1 to 4, wherein said membrane scaffold protein self assembles in the absence of phospholipid to form a nanoscale particle between about 5 nm and about 500 nm in diameter.
6. The membrane scaffold protein of claim 5, wherein said nanoscale particle is from about 5 to about 100 nm in diameter.
7. The membrane scaffold protein of claim 6, wherein said nanoscale particle is from about 5 to about 50 nm in diameter.

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8. The membrane scaffold protein of any of claims 1 to 7, wherein said membrane scaffold protein comprises an amino acid sequence selected from the group consisting of SEQ ID NO:6, SEQ ID NO:9, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:23, SEQ ID NO:29, SEQ ID NO:43, SEQ ID NO:44 and SEQ ID NO:45.
9. A nanoscale particle comprising the membrane scaffold protein of any of claims 1 to 8 and at least one hydrophobic or partially hydrophobic protein, and optionally further comprising a phospholipid or a mixture of phospholipids, wherein said nanoscale particle has a diameter between about 5 nm and about 500 nm.
10. The nanoscale particle of claim 9, wherein the hydrophobic or partially hydrophobic protein is a membrane protein.
11. The nanoscale particle of claim 10, wherein said membrane protein is a tethered membrane protein.
12. The nanoscale particle of claim 10, wherein the membrane protein is an embedded membrane protein.
13. The nanoparticle assembly of claim 10, wherein the membrane protein is an integral membrane protein.
14. The nanoscale particle of claim 13, wherein the membrane protein has seven transmembrane segments.
15. The nanoscale particle of claim 10, wherein said membrane protein is a receptor protein.
16. The nanoscale particle of claim 10, wherein said membrane protein is a G-protein coupled receptor.

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17. The nanoscale particle of claim 16, wherein said G-protein coupled receptor is a 5-hydroxytryptamine receptor.
18. The nanoscale particle of claim 8, wherein said membrane scaffold protein is fused genetically with the hydrophobic protein.
19. The nanoscale particle of any of claims 9 to 18, wherein said membrane scaffold protein comprises an amino acid sequence selected from the group consisting of SEQ ID NO:6, SEQ ID NO:9, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:23, SEQ ID NO:29, SEQ ID NO:43, SEQ ID NO:44 and SEQ ID NO:45.
20. A method for incorporating at least one hydrophobic or partially hydrophobic protein into a nanoscale particle which is stable and soluble in aqueous solutions, said method comprising the step of allowing a membrane scaffold protein and at least one hydrophobic or partially hydrophobic protein to self assemble into nanoscale particles in an aqueous solution, optionally in the presence of at least one phospholipid, whereby nanoscale particles are formed.
21. The method of claim 20, wherein said at least one hydrophobic or partially hydrophobic protein is a membrane protein.
22. The method of claim 21, wherein said membrane protein is a tethered membrane protein, an embedded membrane protein or an integral membrane protein.
23. The method of claim 22, wherein said membrane protein is tissue factor.
24. The method of claim 21, wherein said membrane protein is a receptor protein.
25. The method of claim 24, wherein said receptor protein is a G-protein coupled receptor.
26. The method of claim 25, wherein said G-protein coupled receptor is a 5-hydroxytryptamine receptor.

27. The method of any of claims 20 to 26, wherein said membrane scaffold protein comprises an amino acid sequence selected from the group consisting of SEQ ID NO:6, SEQ ID NO:9, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:23, SEQ ID NO:29, SEQ ID NO:43, SEQ ID NO:44 and SEQ ID NO:45.

28. The method of any of claims 20 to 27, wherein said at least one hydrophobic or partially hydrophobic protein is associated with membranes or membrane fragments.

29 30. A method for identifying an competitor of binding of a ligand to a receptor protein wherein said receptor protein is incorporated within a nanoscale particle together with a membrane scaffold protein, said method comprising the steps of:

(a) contacting a nanoscale particle comprising a membrane scaffold protein and a receptor protein with a detectable ligand to produce nanoscale particle-bound detectable ligand;

(b) contacting the nanoscale particle-bound ligand with a test compound;

(c) measuring detectable ligand released from the nanoscale particles;

whereby a competitor of ligand binding is identified when contacting the nanoscale particle-bound ligand results in release of the detectable ligand.

30 31. The method of claim 30, wherein said receptor protein is a membrane protein.

31 32. The method of claim 31, wherein said receptor protein is a G-protein coupled receptor.

32 33. The method of claim 32, wherein said G-protein coupled receptor is a 5-hydroxytryptamine receptor.

33 34. The method of any of claims 30 to 33, wherein said membrane scaffold protein comprises an amino acid sequence selected from the group consisting of SEQ ID NO:6, SEQ ID NO:9, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:23, SEQ ID NO:29, SEQ ID NO:43, SEQ ID NO:44 and SEQ ID NO:45.

34³⁵. A DNA molecule encoding a membrane scaffold protein, wherein said membrane scaffold protein comprises an amino acid sequence selected from the group consisting of SEQ ID NO:6, SEQ ID NO:9, SEQ ID NO:17, SEQ ID NO:19, SEQ ID NO:23, SEQ ID NO:29, SEQ ID NO:43, SEQ ID NO:44 and SEQ ID NO:45.

35³⁶. A recombinant host cell comprising the DNA molecule of claim 35.

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